

[0029] FIG. 8 is a depiction of a system for manufacture by lamination according to one embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0030] Several embodiments of the present invention and their advantages may be understood by referring to FIGS. 1-8, wherein like reference numerals refer to like elements.

[0031] Referring to FIG. 1, an illustration of a flexible electronic device according to one embodiment of the present invention is provided. Although the present invention is described in the context of an electronic book, it should be recognized that the present invention is not so limited. Indeed, the present invention has applications as other electronic devices, including laptop computers, displays, telephones, remote controls, digital cameras, digital camcorders, personal digital assistants (PDAs), music players, portable video players, video game machines and controllers, etc.

[0032] In general, flexible electronic device 100 may include components that are made of flexible materials, are rigid but have small dimensions, are rigid but can be placed on an area of the device that is less susceptible to bending, or have been "thinned." Examples of flexible materials include plastics, polymers, gels, thin metals, etc. Examples of components that are rigid but may have small dimensions include microprocessors and memory. Examples of thinned silicon devices include display driver chips and microprocessors.

[0033] In one embodiment, a flexible device may be manufactured as a laminate of several layers. In between each layer, or several layers, may be disposed a shock absorbing layer. In one embodiment, the shock absorbing layer may comprise a visco-elastic polymer. An example visco-elastic is Sorbothane®, available from Sorbothane, Inc., Kent, Ohio. Other gels, such as those used for shock absorption in microdrives, may also be used.

[0034] In one embodiment, an adhesive may be provided between each layer or several layers. Several types of adhesives may be used, alone or in combination, to produce the laminate. In one embodiment, different adhesives may be used to bond different layers, different locations, etc. as necessary and/or desired. For example, different electronic components may have different tolerances for heat. Thus, an adhesive that requires an elevated temperature may not be compatible with a particular electronic component, and would not be used in that layer or area of the flexible electronic device.

[0035] Examples of adhesives that may be used include thermoadhesives, RF-cured adhesives, two part adhesives (e.g., epoxy), UV-cured adhesives, air-cured adhesives, etc. Other types of adhesives may be used as necessary and/or desired.

[0036] In one embodiment, an anisotropic conducting adhesive may be used between electrical components and/or printed circuit boards to allow electrical communication between those devices. For example, suitable anisotropic conducting adhesives and films are available from 3M, St. Paul, Minn.

[0037] In one embodiment, the gel that is provided for cushioning may also have adhesive properties or functionalities. Thus, the gel (or combination of gels) may provide multiple functions.

[0038] According to one embodiment of the present invention, the flexible electronic device may be substantially her-

metically sealed. For example, a one-way valve or vent may be provided as necessary in the area of the rechargeable battery to release gas that may accumulate as the battery discharges.

[0039] In another embodiment, the flexible electronic device may be completely hermetically sealed.

[0040] In one embodiment, the flexible electronic device may be sealed by mechanical fastening. For example, the edges of the flexible electronic device may be crimped, welded, etc. Other types of mechanical fastening may be used as necessary and/or desired.

[0041] As noted above, the present invention is directed to a flexible electronic device. FIGS. 2a and 2b provide general examples of how flexibility may be achieved. Referring to FIG. 2a, flexible electronic device 200 includes components 205 and flex points 210. In one embodiment, flex points 210 may be provided at certain areas of flexible electronic device 200 to allow flexible electronic device 200 to bend or fold along, or relative to, each flex point 210. Flex points 210 may be points, lines, curves, areas, etc. as necessary and/or desired to achieve the desired flexibility.

[0042] In one embodiment, a flex point may exist at an area that is thinner than the surrounding areas, thereby increasing flexibility at that point. An example of such a flex point is an area that has been scored. Another example of such a flex point is an area in which material has been removed.

[0043] In another embodiment, a flex point may exist at an area where a material that is more flexible than the surrounding area is used.

[0044] In yet another embodiment, a flex point may exist at an area that has been made discontinuous, e.g., cut, severed, etc.

[0045] Other types of flex points and ways of increasing flexibility at flex points may be used as necessary and/or desired.

[0046] In one embodiment, components 205 may be placed between flex points 210 so as not to interfere with flex points 210. In another embodiment, only components 205 that are rigid may be placed in areas between flex points 210 to not interfere with flex points 210. The number of flex points 210 and the spacing between these flex points 210 may be selected as necessary and/or desired.

[0047] Referring to FIG. 2b, flexible electronic device 200 may also include flex points 210 that are positioned vertically and horizontally. In still another embodiment, flex points 210 may be positioned non-orthogonally, on a curve, etc. In sum, flex points 210 may have any suitable orientation as necessary and/or desired.

[0048] In one embodiment, a greater number of flex points 205 may be provided in the interior of the flexible electronic device 200. In one embodiment, flex points 210 do not have to run the length or width of flexible electronic device 200, but may exist only at one or both edges, in the middle, etc. Any configuration for flex points 210 may be used as necessary and/or desired.

[0049] In one embodiment, the number, orientation, and/or direction of flex points 210 may be selected so as to provide an approximation of continuous flexing to a user. In one embodiment, flex points 210 do not have to be provided through all layers of flexible electronic device 200. For example, a flex point may be provided toward at the upper (when viewed from the top) surface of flexible electronic device 200, but not near the lower surface.